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E. L. Demmon, Director

New Orleans, La.

IMPROVEMENT CUTTINGS IN THE BOTTOMLAND HARDWOOD FORESTS OF MISSISSIPPI

By

J. A. Putnam, Associate Forester,
and
Henry Bull, Silviculturist
Southern Forest Experiment Station

In cooperation with
DELTA EXPERIMENT STATION, Stoneville, Miss.

The major portion of this study was carried on in cooperation with the Mississippi Agricultural Experiment Station under the Cooperative Farm Forestry Act of 1937. An unrevised form of this paper was mimeographed as an Advance Copy, dated August 10, 1940.

The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the station. In some cases, these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

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The Need for Improvement Cuttings

Forty percent of the Yazoo-Mississippi Delta is forest land, a total of about 1.75 million acres. Most of this forest land is well covered with tree growth, but a large proportion of the trees have little or no economic value, either present or prospective. Like a cottonfield choked with brush and weeds, a forest containing many inferior, unprofitable trees cannot produce valuable crops until the inferior material is removed. The removal of inferior trees is called an improvement cutting and constitutes a very important part of practical forestry or forest management.

It is a common misconception that forestry consists largely of planting trees, or reforestation. In some forest regions the planting of trees is of major importance, but in the Delta comparatively little forest land requires planting. The Delta has very great need for improvement cuttings, however, since the second-growth forests growing up amid the remnants of the original forests, without any management or protection, leave much to be desired. The benefits to be derived from improvement cuttings are so great that it will pay every owner and manager of forest land in the Delta to acquaint himself with the principles and how to apply them, even if only in the cutting of fuel wood for the plantation. This paper contains recommendations for improvement cuttings based on the objective of maximum profit from wood products alone. In some cases it may be desirable to preserve shelter and food for wildlife by refraining from cutting trees that should be removed from the standpoint of timber management alone.

Improvement cuttings are especially needed in bottomland hardwoods because of the great variety of tree species and the great differences in the values not only of the various species but also of different trees of the same species. Some species are exceedingly valuable, others almost or entirely worthless. Individual trees of the same species, moreover, often vary in quality and value even more than do different species. Hardwoods of the same species vary in form from almost perfect individuals with long, straight, clear trunks to crooked, forked, widespreading "wolf trees," hardly worth cutting even for fuel wood, but occupying several times the normal growing space of trees their size and suppressing more promising neighbors. This same spread in value occurs even between well-formed individuals of the same species, because of variation in the quality of the

trunk. Some trees yield almost perfect logs, while grubs or other insects, knots, bird peck, stain, ingrown bark, shake, or dote make the logs of other individuals of the same species useless for anything but fuel wood.

Commercial uses for Delta species place a high premium upon the cutting of choice trees and a penalty upon the cutting of poor ones. This accounts in large part for the high proportion of poor trees in the present stands. Delta species also are notably subject to fire injury and to subsequent decay that enters through fire scars.

About 20 percent of the trees in an average second-growth stand in the Delta are outright culls, while another 20 to 30 percent should be removed to facilitate the growth of better individuals already present, or to allow the seeding-in of promising new growth. In addition, there is usually 15 to 20 percent of the area that, due to overcutting and repeated burning, bears little or no established forest cover at all. Heavy grazing also is very detrimental in some localities. In view of this large aggregate proportion of the area (more than half) which usually needs reseeding and will reseed naturally after improvement cutting, with protection from fire and overgrazing, it is unfortunate that some of the poorer species, such as bitter pecan, overcup oak, and boxelder, are exceedingly prolific seeders. Special efforts, therefore, should be made in improvement cuttings to reduce the crop of undesirable seed and to maintain the supply and increase the proportion of desirable seed. After protection from fire, the outstanding needs in most Delta forests are the elimination of worthless individual trees, the reduction of the proportion of undesirable species, and the release of thrifty, desirable growing stock for optimum growth and development. These are the objectives of improvement cuttings.

Setting Up Cutting Standards

Many questions must be answered before improvement cuttings can be conducted with maximum efficiency and optimum results. Research in this field in the Delta was lacking until September 1939, when the Southern Forest Experiment Station, an agency of the U. S. Forest Service with headquarters in New Orleans, La., began a study at the Delta Experiment Station, Stoneville, Miss., in cooperation with the Mississippi Agricultural Experiment Station. The work was augmented in February 1940 through the establishment of a research project under the Cooperative Farm Forestry Act of 1937.

The study is being conducted on a 2580-acre tract of cut-over forest owned by the Delta Experiment Station and located only $2\frac{1}{2}$ miles north of the station. The current improvement cutting experiment, which occupies 90 acres, will serve also as a demonstration of improvement cutting and soon will be readily accessible to interested visitors. A system of permanent signs and marks on representative trees in an uncut check plot will show which trees should be cut, which should be left, and explain why each marking was for "cut" or "leave." The results of applying the principles set forth can be inspected in adjacent improved plots. When the experimental and demonstration cuttings have been completed, a report on the volumes cut and left and on the returns from the operation will be issued. The specific directions given in this paper for making improvement cuttings were developed from the Stoneville study.

There are no hard and fast rules for making an improvement cutting. In general terms, the poor trees are cut and the good trees are left. "Poor" and "good" are such indefinite words, however, that at least a few specific cutting rules or recommendations must be used as a guide if the work is to be done logically, efficiently, and consistently. Specific cutting rules are given, therefore, in a later section. It should be thoroughly understood that their application is an art rather than a science.

Before stating the cutting rules or recommendations, the principles and tests on which they are based will be discussed briefly. There are five considerations that affect the decision whether or not to cut any given tree in an improvement cutting:

(1) Species
(2) Size
(3) Form and quality
(4) Vigor and thrift
(5) Position and space occupied

The practical use of these tests in making an improvement cutting may seem complex or difficult, but after a little experience it is actually rather simple. It frequently happens that a single glance at a tree shows that one consideration stands out above all the others, and that this alone is a sufficient basis for a decision as to whether to cut or to leave the tree. For example, the tree may be of such obviously low vigor and poor thrift as to be dying, or it may have passed its period of optimum development and show obvious signs of deterioration, or it may be more than half burned through at the butt and in danger of blowing over. All such trees that have any present value should be cut to salvage this value before death or further deterioration, regardless of other considerations. In other cases, two or three considerations taken together may stand out and make it unnecessary to look further. In brief, it is usually unnecessary to take up each test systematically or in order for each tree. It is usually possible to note one or two outstanding characteristics that in themselves are enough to determine the fate of the tree.

The five considerations will be taken up in order and discussed briefly:

(1) Species. There are at least two dozen separate species of trees in most bottomland hardwood forests, but these are best considered in only three groups in making improvement cuttings. In this paper the three classifications, "best," "intermediate," and "poorest," are based primarily upon commercial values. The common tree species of the Yazoo-Mississippi Delta are grouped as follows (see p. 14 for scientific names and other common names):

Poorest species (weeds)	Intermediate species	Best species
Boxelder	Overcup oak	Bottomland red oak
Waterlocust	White elm	Willow oak
Hawthorn	Rock elm	Water oak
Planertree	Winged elm	Cherrybark oak
Ironwood	Hackberry	Cow oak
Swamp privet	Willow	Cottonwood
	Red maple	White ash
	Sweet pecan	Green ash
	Bitter pecan	Redgum
	Hickories	Persimmon
	Honeylocust	Mulberry
	Sycamore	Cypress
	Blackgum	
	Swamp cottonwood	

Why the different species were classified in this way is best illustrated by a few examples. A bottomland red oak log is worth more than an elm log of the same size and quality; so bottomland red oak is considered a better species than elm. A bottomland red oak log and an overcup oak log of the same size and quality are of about equal value, but red oak is several times more likely than overcup to yield large, high-grade logs. The red oak also grows more rapidly than the overcup oak. Hence, there are at least two good reasons for considering red oak the better species.

The poorest species are merely "weeds" of little or no economic significance. They should be eliminated just as rapidly as practicable in order to provide space for more valuable species. Shrubs and vines also should be treated as weeds and cut if they are large and interfere with trees or reproduction of the best or intermediate species.

(2) Size. Only two size classes need be considered: Under-sawlog size, and sawlog size. The boundary between these two classes is set arbitrarily at 14 inches d.b.h. (diameter at breast height). Trees 14 inches and larger are considered to be sawlog size; smaller trees, under-sawlog size. Usually a good lower limit in an improvement cutting is 5 inches d.b.h., since smaller trees are generally unmerchantable and unusable, and their effect in the forest, even if undesirable, is relatively slight.

(3) Form and quality. This is especially important, but often hard to judge. Experience gained from seeing trees and logs cut up is invaluable, although not an infallible guide. The principles, however, are simple. The goal of management in the bottomland hardwoods is assumed to be the production of straight, high-quality logs, suitable in large sizes for industrial lumber and veneer, and in small sizes for cooperage, small-dimension stock, and specialties. These are the only logs for which there is ordinarily a profitable cash market, and they will be referred to hereafter as "high-grade" logs. A high-grade log is defined here as one which is at least 10 inches in diameter inside the bark at the small end, at least 12 feet long, straight enough to be handled as one piece, and with at least 60 percent of its surface

entirely clear of defects.[1/] If a tree does not now contain at least one high-grade log, or will never develop one because of its poor form or low quality, it is not a desirable tree to retain since it does not satisfy the goal that has been set up. The terms "at least one high-grade log" and "at least one actual or potential high-grade log" therefore are used frequently in the cutting rules. They are convenient terms for describing briefly a minimum quality. The requirements are easily memorized and trees meeting them are readily recognized in the woods, subject to differences of opinion as to the presence and extent of defects.

Helpful information on how to recognize the presence and extent of defects in bottomland hardwoods is almost impossible to furnish on paper without the aid of good photographs. Such pictures are not yet available and the present discussion of defects will therefore be confined to the brief tabulation of the more important kinds of defect, on page 6. This will be useful even if it only calls attention to some defects that might not otherwise be considered at all.

(4) Vigor and thrift. From the standpoint of vigor and thrift, there are two classes of trees that always should be removed in an improvement cutting. These are (a) "poor risks," and (b) overmature trees.

A "poor risk" is a tree, containing merchantable or useful material, that is unlikely to remain alive until the next time a cutting is made. If no other cutting is definitely scheduled, this period should be assumed to be 5 to 10 years. There are many reasons why a tree may soon die and most of these are obvious at a glance. The tree may be leaning badly or deeply fire-scarred at the butt, hence likely to blow over. It may have a dead top, dying branches, and scanty, unhealthy foliage. It may be seriously suppressed by neighboring trees, with no growing space and only a very small amount of foliage. Poor risks should be cut in order to salvage their value.

An overmature tree is one that has already attained large size for its species and shows evidence of decreasing vigor and quality. Decreasing vigor is shown by a slow and decreasing growth rate, scanty and pale foliage, a stag-headed crown (i.e., a crown with large dead branches at the top), and usually by bark that is much rougher and less uniform in thickness and color than is found on younger, fast-growing trees of the same species. Decreasing quality is not so readily observable, but implies that decay and other defects are developing faster than the tree is growing. Overmature trees should be removed in improvement cuttings because of their deterioration and progressive loss in value; they are trees that should have been harvested earlier when they were mature.

Most Delta hardwoods of the best and intermediate species do not become overmature until they are about 30 inches in diameter at breast height, but there is a considerable difference between species and also between individuals of the same species in this respect. Hackberry and persimmon are usually overmature after reaching 20 to 24 inches in diameter, whereas the red and

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1/ The 60 percent must be made up of sections at least 4 feet long that may occur on any or all 4 sides or faces of the log (conceived as squared), or of 3-foot sections aggregating at least 2/3 of the log length which are entirely clear full length for at least 7/8 of their circumference.

Kind of defect	External indications or occurrence	Importance
Surface knots	Limbs or stubs.	Prevent logs from being classed as high-grade when so placed that less than 60 percent is surface-clear.
Blind or hidden knots	Whorls or "puddles" that resemble the mark made by throwing a stone out of sight into soft mud.	Affect present clearness about same as surface knots. Quality will improve rapidly, however, with a good growth rate.
Visible decay	Usually associated with fire scars or limb stubs.	Likely to be overrated in fire-scarred gum, ash, and persimmon. Usually difficult to estimate, but most serious in old or slow-growing trees, and where a large proportion of the butt seems to be affected.
Hidden decay	Swollen trunk, old scars, discolored bark. Sometimes no external indication.	
Grub holes	Small exit holes (about 1/4" diameter) and small vertical scars. Most common in oaks, and usually in old slow-growing or injured trees.	If numerous, prevent logs from being classed as high-grade.
Bird peck	Sapsucker peck marks, usually circling the trunk.	Prevents logs from being classed as high-grade unless the marks are fresh and the log is large.
Bark pockets (small patches of bark embedded in the wood)	Rough or pitted bark, usually on old or slow-growing trees. Most common on oaks, hickories, and pecans. Difficult to determine.	If abundant, prevent logs from being classed as high-grade.
Ring shake (cracks between the annual rings)	No infallible guides, but most common in bitter pecan and in leaning or crooked trees.	Bad effect on lumber greatly increased if the tree has sweep. Prevents most bitter pecan from yielding high-grade logs.
Worm holes	Usually associated with open, infected injuries, usually fire scars. No certain indication.	If numerous, prevent logs from being classed as high-grade.
Mineral stain (blue or green discoloration of the wood)	Most common in unthrifty fire-scarred trees on the lowest and wettest sites. No certain indication.	Prevents logs from being classed as high-grade.

water oaks, redgum, cypress, and cottonwood usually reach 30 to 40 inches in diameter before they become decadent. Cypress is especially apt to go far beyond this limit. The approximate limits for other common species are: Mulberry, 12 inches; willow and red maple, 24 to 30 inches; and overcup oak, green ash, bitter pecan, rock elm, white elm, sycamore, and honeylocust, 26 to 36 inches. All species generally become overmature at smaller sizes on the poorer sites, and this is especially true of bottomland red oak.

(5) Position and space occupied. This consideration is important mainly in stands where most of the trees are relatively desirable. It is of comparatively little importance where most of the trees are intrinsically poor and undesirable. Only three classes of trees need be considered here: (a) Trees with poor growing space, (b) trees that interfere with better trees, and (c) wolf trees.

Trees with poor growing space are those that are overtopped by others or that are seriously crowded on at least 2 sides by trees of similar or larger size. This is not a reason in itself for cutting, but it may be a supplementary reason.

Trees that interfere with better trees are those which are so close as to prevent the best development of the better individuals. These interfering trees should be removed for obvious reasons.

Wolf trees are those with unusually large crowns. They occupy excessive space, especially when their quality is considered, and interfere with the development of better trees or of desirable seedlings that could get a start if the space were available. Wolf trees are usually of low quality because of limbs and knots of excessive number and large size, and because their trunks are clear for only a very short length above the ground. Wolf trees have no place in a well-managed forest.

Cutting Rules

It is impossible to make a general statement as to how far to go in removing poor or undesirable trees. Usually this is determined by the area to be covered in a given period and by the extent to which forest products can be used or sold. The principle that the poorest trees should always be cut first, however, is applicable in all cases. Specific cutting rules are accordingly presented below in four groups or sets. The first set of rules provides for the cutting of only the very poorest trees—those that should be cut first. If a heavier cutting seems desirable, the second set of rules should be used also. For a still heavier cutting, the third set of rules should be added. These three sets of rules have been combined in tabular form on page 10, since in fairly well-stocked stands this results in a suitable first improvement cutting. Going beyond this point probably is inadvisable except under special circumstances such as the immediate need for a large volume of wood per unit of area, or where the stand is exceptionally well stocked or overstocked. To provide for such a cutting, however, a fourth set of cutting rules is given.

The trees described below should be cut into products of the greatest possible use or value. Trees which contain so little usable material that they are not worth cutting, especially large culls that will seriously damage valuable neighboring trees if felled, should be killed by girdling. Trees that cannot be used at present, but contain appreciable potentially usable material, should not be cut until a use or market develops.

Cut first:

1. Poor risks (merchantable or useful trees unlikely to remain alive until the next cutting).

2. Trees seriously decayed or grubby, hence likely to decrease in value.

3. Overmature trees, which have passed their optimum development and should be harvested before further deterioration occurs.

4. Sawlog-size trees of the poorest species that do not contain at least one high-grade log, and of intermediate species that do not contain at least one usable log.

Cut second:

1. Trees of the poorest or intermediate species, regardless of size, that do not or will never contain at least one high-grade log and are either (a) wolf trees (occupying excessive space), or (b) trees that will have poor growing space even after the improvement cutting.

2. Trees of the poorest or intermediate species that interfere seriously with the growth of better trees (a) of the best species at least 4 inches in d.b.h.,[2] or (b) of intermediate species at least 6 inches in d.b.h.

Cut third:

1. Remaining sawlog-size trees of the poorest species regardless of position or quality.

2. Under-sawlog-size trees of the poorest or intermediate species that interfere seriously with the growth of better trees (a) of the best species at least 1 inch in d.b.h. or (b) of intermediate species at least 4 inches in d.b.h.

3. Sawlog-size trees of intermediate species that do not contain at least one high-grade log, or that are very large wolf trees not containing more than one high-grade log.

2/ D.b.h.—diameter at breast height, i.e., at $4\frac{1}{2}$ feet above the ground.

4. Under-sawlog-size trees of the best species that (a) will never contain at least one high-grade log and will have poor growing space even after the improvement cutting, or (b) interfere seriously with better trees of intermediate or best species at least 4 inches in d.b.h.

5. Wolf trees of the best species that do not or will never contain at least one high-grade log, or more than one high-grade log if more than 20 inches in d.b.h., unless needed for seed.

6. Sawlog-size trees of the best species that do not contain at least one usable log, unless needed for seed.

Cut fourth:

1. Remaining under-sawlog-size trees of the poorest species.

2. Remaining under-sawlog-size trees of intermediate species that will never contain at least one high-grade log.

3. Remaining trees of the best species that do not or will not contain at least one merchantable or usable log, unless needed for seed.

Utilization of Trees Removed

Improvement cuttings ordinarily yield products mostly of low commercial value. Nevertheless, if the cutting is regulated with careful consideration of current needs and markets, and the better portion of the stand is left for further growth and increase in value, it should be profitable to improve all but the most inaccessible forest properties in the Delta. Although materials removed will be valuable mainly for domestic uses such as fuel wood and posts, most tracts will yield some material for which there is a good cash market. The products that may be obtained from improvement cuttings are discussed below, in order of increasing utility or value.

1. Fuel wood. Most fuel wood will be used on the plantation or in the immediate neighborhood, although towns not more than a short truck haul distant may offer good markets. The total amount of fuel wood used annually in the Delta is equivalent to several million board feet of logs, and a substantial part actually is cut from sawlog or potential sawlog trees. If fuel wood were obtained only through improvement cutting, a long step would be taken toward returning Delta woodlands to a productive and profitable condition. Fuel wood should be cut only from trees for which no higher use is available, such as inferior small trees, topwood, and cull trees that are too crooked or rough to work into higher-class products.

<table>
<tr><td rowspan="2">Diameter at breast height in inches</td><td>Poorest species</td><td>Intermediate species</td><td>Best species</td></tr>
<tr><td>Boxelder
Waterlocust
Hawthorn
Planertree
Ironwood
Swamp privet</td><td>Overcup oak
White elm
Rock elm
Winged elm
Hackberry
Willow
Red maple
Sweet pecan
Bitter pecan
Hickories
Honeylocust
Sycamore
Blackgum
Swamp cottonwood</td><td>Bottomland red oak
Willow oak
Water oak
Cherrybark oak
Cow oak
Cottonwood
White ash
Green ash
Redgum
Persimmon
Mulberry
Cypress</td></tr>
<tr><td rowspan="2">5 - 13 (under sawlog size)</td><td colspan="3">Cut only:
(1) Poor risks (from viewpoint of survival).
(2) Trees seriously decayed or grubby.
(3) Trees that will never produce at least 1 high-grade log and that have poor growing space.
(4) Wolf trees that will never produce at least 1 high-grade log.</td></tr>
<tr><td colspan="2">(5) Trees that interfere seriously with better trees of the best species at least 1 inch d.b.h., or of intermediate species at least 4 inches d.b.h.</td><td>(5) Trees that interfere seriously with better trees of intermediate or best species at least 4 inches d.b.h.</td></tr>
<tr><td rowspan="2">14 and more (sawlog size)</td><td rowspan="2">Cut all trees.</td><td colspan="2">Cut only:
(1) Poor risks (from viewpoint of survival).
(2) Trees seriously decayed or grubby.
(3) Overmature trees.
(4) Wolf trees that don't contain at least 1 high-grade log, or wolf trees more than 20 inches d.b.h. that don't contain more than 1 high-grade log.</td></tr>
<tr><td>(5) Trees that don't contain at least 1 high-grade log.
(6) Trees that interfere seriously with better trees of the best species at least 4 inches d.b.h., or of intermediate species at least 6 inches d.b.h.</td><td>(5) Trees that don't contain at least 1 usable log.</td></tr>
</table>

A <u>high-grade log</u> is one that is at least 10 inches in diameter inside the bark at the small end, at least 12 feet long, straight enough to be handled as one piece, and with at least 60% of its surface entirely clear of defects.

<u>Application, to insure flexibility and adaptation to widely different conditions:</u>

More decay and grubbiness, and poorer form, are tolerated in the best species than in the other two groups.

Where the stand is light, or the trees very poor and the cut relatively heavy, poorer trees are tolerated than where the stand is heavy or the cut relatively light. Also, in light stands or in heavily cut stands, some trees of the best species may be left for seed production even though the rules call for cutting them.

2. Posts, pulpwood, and chemical wood. The straighter, cleaner portions of the stems of small trees down to 5 inches in diameter at breast height together with such 7-foot lengths of straight, clean material as occur in cull trees and tops often may prove of more value as posts than as fuel wood. Nothing should be used for posts that is suitable for a more valuable use. A small tree good enough to make a post often will make a high-grade sawlog when it is larger, and such trees should not be removed in an improvement cutting. Of the common Delta species, only heart cypress, heart overcup oak, and mulberry are worth using for untreated posts, since the others are subject to rapid decay. Much time and material is wasted in the Delta every year through the use for posts of species which decay and fail within 3 years. Most of these species, however, can be creosoted by the open-tank, hot-and-cold-bath process to provide posts of high durability.

Pulpwood is at present salable from only one Delta species, cottonwood, but it is probable that a demand for pulpwood from nearly all of the softer hardwoods will develop. Pulpwood should be cut from the same class of material that provides fuel wood, excluding material that will not yield a 4- or 5-foot length straight and clean enough to peel readily, and at least 4 inches in diameter. Wherever there is a market, pulpwood usually is the most profitable product for all sizes and qualities of material up to common sawlog or stave timber. Post utilization cannot compete with pulpwood except where preservative treatment is unnecessary.

At present chemical wood in the Delta can be sold to only one plant, which uses reasonably sound, straight wood of only the heavier species such as oak, pecan, locust, and rock elm. Size requirements are about the same as for pulpwood, but the bolts do not have to be peeled.

3. Stave, small-dimension, and specialty stock. The required quality is approximately the same for all of these uses, the principal differences being in species and value. Only clear, high-grade material is usable, but small sizes can be used down to 8 to 12 inches, and short lengths are generally acceptable and often preferred. The most valuable species is persimmon, which cannot be used in any other way except for treated posts and fuel wood. Ash is the next most valuable species, but except in small sizes and short lengths bottomland ash is equally valuable for lumber. At the other extreme, nearly all of the softer woods are readily salable as slack stave bolts at a low stumpage value. This value, however, is about as high as ordinary saw-timber value for most of these species except in the case of large choice logs, which will bring substantially more as saw timber. In fact the only ready market at all for some species is for slack stave manufacture. Hackberry is probably the best example of this.

Oak down to 12 inches is used to some extent for low-grade tight cooperage and also for direct cutting into blanks for implement and furniture stock, but stumpage values usually are low. Pecan is, less often, cut directly into blanks for implement stock and athletic goods at rather low values, and the use of small material is severely limited. It is desirable, therefore, to leave straight, clear, small trees of oak and pecan to grow into commercial saw timber whenever feasible, as in most cases the market would not absorb them and they would have to be used locally as low-grade sawlogs or posts.

4. Saw timber. Two distinct classes of saw timber must be recognized in any realistic consideration of hardwood utilization and values. In the first class are large, high-grade logs, reasonably clear of all types of defects and 16 to 20 inches and larger, plus especially clear logs down to about 14 and occasionally even 12 inches which come principally from the butts of the smaller trees. This is the class of timber cut by the hardwood lumber and veneer industries, which produce almost entirely for factory use. A fairly adequate market for such timber still remains in the Delta. Staple species, such as gum, oak, and ash are readily salable at good prices, while other species, such as elm, sycamore, and willow sell less readily and at lower prices for higher specifications. Pecan, rock elm, and locust are only occasionally salable, and then only to relatively few mills and at low prices for very high specifications.

The second class comprises the remaining sound, common sawlogs with no established commercial market. There is no outlet at any price for all or even a large proportion of this class of timber. Small fractions of the best of these sawlogs can be disposed of at low prices with (but never separate from) high-grade logs sold to lumber mills. Limited amounts may be sold in the form of ties, timbers, and planking, or cut up by small farm mills and used locally for the commonest types of construction. A large part of this class of timber, especially the thrifty small and medium-sized trees, should be retained as growing stock and should not be forced onto the market until it has become larger and of a quality more readily salable at a better price. Better manufacturing and marketing facilities for such timber undoubtedly will develop in the Delta, much as they have already developed in other hardwood regions.

Benefits of Improvement Cutting

The benefits obtained from improvement cuttings are especially substantial from the viewpoint of future rate of return upon the present investment. A rather large immediate net return often can be obtained by harvesting a variety of products in a single systematic improvement cutting, where little or nothing could be realized by haphazard cutting for a single product or by the usual random, destructive felling for plantation needs. The usual immediate result of improvement cutting, however, is a small net return over the costs of operation. In many circumstances, mere recovery of the greater part of the cost will justify the enterprise.

Any immediate net cash loss in an improvement cutting, or any net disadvantage in immediate income as compared to the possible returns of an unregulated cutting, should be regarded as an investment in the rehabilitation of the property and the building up of its productive capacity. Such a policy is comparable to the sound business practice of investing capital in the development of run-down and mismanaged but potentially profitable farms and plantations, looking toward the time when the property will again pay good returns on the investment. Aside from immediate income, the following advantages accrue from effective improvement cutting:

1. Use of high-quality trees for low-quality purposes is stopped and the trees either cut for their best use or left to grow and develop their full value. For example, it is common practice to fell thrifty young ash and red oak indiscriminately for fuel wood and high-grade oak for ties and farm lumber. This kind of cutting is the very opposite of improvement cutting.

2. A large volume of timber is cut and used that would ordinarily die of natural causes before it would be reached under the usual haphazard system of cutting and marketing. This has the additional advantage of saving an equivalent amount of promising growing stock which might be cut instead.

3. Only the more thrifty, promising trees are left as an investment, and their growth rate is increased by the removal of the competition of the poorer trees. Considering the great increase in volume over a period of years, together with the increase in value per unit volume, a very high rate of compound interest is earned on the relatively small capital value of the residual timber. This is especially true of the smaller trees left in an improvement cutting.

4. Removal of large trees of little value greatly increases the area in actual productive use by furnishing room and opportunity for new growth to seed in.

5. The ultimate effect in average cut-over and second-growth forests in the Delta will be to increase the present productivity about four times in volume (to about 400 board feet per acre per year, plus a substantial amount of cord-wood and posts) and at least six times in value. Although returns will be low or even lacking for a number of years in all but the best second-growth stands, the eventual result will be a property that can be managed to yield a good sustained income.

SCIENTIFIC NAMES OF SPECIES MENTIONED IN TEXT

The common names used in the text are in most cases those in common use in the Yazoo-Mississippi Delta. These, together with the common names accepted by the Forest Service and the scientific names, are given below:

Common name in the Delta	Common name accepted by the Forest Service	Scientific name
Ash, green or swamp	Green ash	Fraxinus pennsylvanica lanceolata (Borkh.) Sarg.
Ash, white or cane	White ash	Fraxinus americana L.
Boxelder	Boxelder	Acer negundo L.
Black gum	Black tupelo	Nyssa sylvatica Marsh.
Cottonwood	Southern cottonwood	Populus deltoides virginiana (Castigl.) Sudw.
Cottonwood, swamp	Swamp cottonwood	Populus heterophylla L.
Cypress	Baldcypress	Taxodium distichum L. (Rich.)
Elm, rock	Cedar elm	Ulmus crassifolia Nutt.
Elm, white or soft	American elm	Ulmus americana L.
Elm, winged or hard	Winged elm	Ulmus alata Mich.
Hackberry	Sugarberry	Celtis laevigata Willd.
Hawthorn	Hawthorn	Crataegus spp.
Honey locust or thorn tree	Honeylocust	Gleditsia triacanthos L.
Ironwood	American hornbeam	Carpinus caroliniana Walt.
Maple, red or soft	Red maple	Acer rubrum L.
Mulberry	Red mulberry	Morus rubra L.
Oak, bottomland red or pin		Quercus nuttallii Palmer
Oak, cherrybark or scaly-bark	Cherrybark oak	Quercus rubra leucophylla Ashe
Oak, cow	Swamp chestnut oak	Quercus prinus L.
Oak, overcup or swamp post	Overcup oak	Quercus lyrata Walt.
Oak, water or striped or spotted	Water oak	Quercus nigra L.
Oak, willow or pin	Willow oak	Quercus phellos L.
Pecan, bitter	Water hickory	Hicoria aquatica (Mich.) Britt.
Pecan, sweet	Pecan	Hicoria pecan (Marsh.) Britt.
Persimmon	Common persimmon	Diospyros virginiana L.
Planer tree or water elm	Planertree	Planera aquatica (Walt.) Gmel.
Privet, swamp	Common adelia	Forestiera acuminata (Mich.) Poir.
Red gum	Sweetgum	Liquidambar styraciflua L.
Sycamore	American sycamore	Platanus occidentalis L.
Water locust or thorn tree	Waterlocust	Gleditsia aquatica Marsh.
Willow	Black willow	Salix nigra Marsh.